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ABSTRACT

The tool handling unit is presented to assist apprentices to acquire a general knowledge on the use of various basic tools. The unit consists of seven modules: (1) introduction to hand tools and small power tools; (2) measuring tools: layout and measuring tools for woodworking; (3) measuring tools: feeler gauge, micrometer, and torque wrench; (4) cutting and shaping tools--hand saws (wood), planes, wood chisels, hacksaws, cold chisels, and files; (5) holding and fastening tools--wrenches; sockets, socket handles, and attachments; pliers and wire cutters; screwdrivers; and hammers; (6) boring and drilling tools--punches, electric drills and drill bits, and braces and auger bits; and (7) soldering. Each unit contains information on the following areas: objectives, references (mainly textbooks), content, instructional suggestions, and detailed background information. (EC)

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TOOLS

UNIT 9

A CORE CURRICULUM
OF RELATED INSTRUCTION
FOR APPRENTICES

The University of the State of New York/THE STATE EDUCATION DEPARTMENT
Bureau of Occupational and Career Curriculum Development, Albany, New York 12234
1975

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FOREWORD

Apprentice training is a systematic way of providing the skilled workers necessary to supply current and future employment demands. Related instruction is an integral part of a planned apprentice training program — ranking in importance with the skills learned on the job. The related instruction provided to apprentices helps them better understand the trade and to know *why* things are done as well as *how* they are done.

A *Core Curriculum of Related Instruction for Apprentices* was designed to provide relevant instruction to apprentices preparing for a variety of trades. It includes the general topics appropriate to all who will be taking their place in the national workforce. Therefore, presentation of related instruction to a mixed group of apprentices becomes a feasible and manageable activity which helps fulfill the legal requirement for this component of a full apprentice program. It leaves the trade-specific information to be provided as the need arises.

The core curriculum is developed in major units or general topics. Modules within each unit are designed as self-contained instructional packages which can be selected for presentation to meet individual and program needs. The objectives of each module are expressed in terms of expected terminal performances which each apprentice should exhibit as a result of instruction. This allows any apprentice who is able to accomplish the student objectives to move on to another module. The program provides sufficient flexibility for the development of instruction to meet the specific needs of a variety of apprentices with differing backgrounds and expectations.

This unit, *Tools*, is one of nine units that have been developed to provide the apprentice with the skills in the use of a variety of basic tools. The Administrative Considerations and Instructional Considerations which are helpful to administrators and journeymen/instructors in developing and conducting an approvable course in related instruction are contained in Unit I, Introduction to Apprenticeship. It is suggested that reference to that unit be made by all who will instruct this unit.

Content relating to the core curriculum was developed under grant at the New York State School of Industrial and Labor Relations, Cornell University, Ithaca, under the supervision of Professor Felician F. Foltman. Assistance relating to content was provided by Charles A. Stebbins, Associate in the Bureau of Trade and Technical Education, with the concurrence of Carl G. Benenati, Chief, who is responsible for the approval and conduct of related instruction programs for apprentices. The material developed was adapted to a curricular format and prepared for publication by Nelson S. Maurer, Associate in the Bureau of Occupational and Career Curriculum.

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INTRODUCTION TO HAND TOOLS AND SMALL POWER TOOLS

Explains the importance of acquiring good tools, keeping tools clean and repaired, using tools properly, and storing tools properly

OBJECTIVES

At the completion of this module students will be able to:

1 *Identify the characteristics of a good tool*

2 *State the importance of proper use of tools*

3 *State the importance of keeping tools clean and maintained*

4 *Explain how to store tools properly*

5 *State why returning borrowed tools and shop tools is important*

REFERENCES

(A) General Motors Corporation. *ABC's of hand tools.* Detroit, Mich. The Corporation. 1945.

(B) Stockel, M.W. *Auto service and repair.* Homewood, Ill. Goodheart-Willcox Co., Inc. 1969.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Characteristics of a Good Tool (1)	*Use actual anecdotes to emphasize specific points in this module.*	Today a good small power or hand tool is usually relatively lightweight. This is because the manufacturer is using stronger and lighter materials in tools. The stronger the material, the less material is needed to produce a strong tool. This is especially important with wrenches and sockets which are easier to work with if they have thin walls and sides.
• Weight (1)	Obtain samples of high and low quality tools. Ask students to indicate the quality of each tool and to give reasons for his choice. (Ref. A; Ref. B, pp. 1-7 — 1-8)	
• Finish (1)		A good tool usually has a smooth shiny finish which is easy to keep clean, and which can be marked with the owner's name or initials.
• Guarantee (1)		A reputable tool manufacturer will often sell tools with a lifetime guarantee. Tools from such manufacturers are usually more expensive,

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Guarantee (1) (cont'd)		but are cheaper in the long run since the manufacturer offers free replacement for any tool which breaks. Also, it makes sense to buy tools from a manufacturer who has at least one dealer in the area. A lifetime guarantee on tools is not worth much if there is no dealer around to honor the guarantee.
Reasons for Using Tools Properly (2)	Ask students to list common types of injuries that may result from the misuse of specific types of hand tools and to suggest ways these injuries may be prevented. (Ref. A; Ref. B, pp. 1-7 — 1-8)	
• Safety (2)		Proper use of tools is a basic safety procedure. Improper use of tools can result in injury or death. Injuries make a worker less productive or nonproductive, and less able to make a living and provide for himself and his family.
• Tool Damage (2)		Using tools improperly often breaks them. Even if a worker can eventually get a replacement under a guarantee, tool breakage slows him down. He must borrow a tool from a coworker or get a new one from the tool room. Workers are often reluctant to lend tools to people who have a reputation for breaking them.
• Damage to Work (2)		Often a worker who uses tools improperly also damages what he is working on such as scratching the car finish with a screwdriver or stripping the head of a bolt. The worker then has to repair the damage or pay to have it repaired.
Reasons for Keeping Tools Clean and in Working Order (3)		
• Safety (3)		Clean tools are safer to use since they are less slippery and can be gripped more securely.
• Quality of Work (3)		Clean and properly maintained tools do not damage the work as readily as do dirty tools. This is especially important in the machine and mechanical trades since dirt is a prime enemy of machinery.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Life of Tool (3)		Clean and properly maintained tools usually last longer than dirty tools. Dirt wears down surfaces and may encourage the formation of rust, which will often damage tools quickly and irreparably.
Storage of Tools (4)	Invite a tool crib supervisor to explain the importance of the proper care and maintenance of tools.	
• Accessibility (1)		Tools should be stored in a chest or tray so they can be moved easily if need be. Tools should be stored according to some system, or so that the worker can find them when he needs them, and can tell at a glance which tools are missing.
• Care During Storage (4)		Delicate measuring tools should be placed in protective cases and preferably be stored away from less fragile tools which get a lot of use. Cutting tools such as files and chisels should be separated from other tools to protect their cutting surfaces. Tools which will rust should be lightly oiled.
Reasons for Returning Borrowed Tools (5)		
• Cost (5)		Tools are costly. When a borrowed or shop tool is not returned, someone winds up paying for it directly or indirectly.
• Relations With Coworkers (5)		People are reluctant to lend their tools to persons who have a reputation for not returning them. Those individuals who return borrowed tools to their owners can reasonably expect others to do the same with their tools.

MEASURING TOOLS: LAYOUT AND MEASURING TOOLS FOR WOODWORKING

Identifies and explains correct procedures for the use and care of woodworking measuring and layout tools

OBJECTIVES

At the completion of this module students will be able to:

1 *Identify types of and explain and demonstrate correct procedures for the use and care of linear measuring tools*

2 *Identify types of and explain and demonstrate correct procedures for the use and care of various types of squares*

3 *Identify types of and explain and demonstrate correct procedures for the use and care of various types of gauges*

4 *Identify and explain and demonstrate correct procedures for the care and use of levels*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

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CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Use and Care of Linear Measuring Tools (1) • Rules and Tapes (1) · Types (1)	*Devise practical situations that require the use of woodworking layout and measuring tools which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs.* (Ref. A, pp. 62-69) *During the practice periods supervise the students carefully to see that they are using correct procedures.*	Rules used by woodworkers are usually made of wood and fold so they can be carried in the pocket. They come in lengths from 2 to 8 feet and are marked off in feet, inches, and fractions of inches. Common rules are the zig-zag folding rule, the caliper rule used to measure the diameter of dowels and drills accurately, the boxwood rule, and the steel tape. For accurate measurement of distances longer than 2 feet, a folding rule should be laid flat on the surface and not held on edge. This helps to keep bending, which hinders accuracy, to a minimum. Steel tapes are laid out in a straight line to give accurate measurements. Many steel tapes have the dimension of the case added to the tape in order to get a reading when it is not possible to run the tape all the way out.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
· Care and Maintenance (1)		All measuring instruments become practically worthless when warped, bent, broken,or illegible. Keep rules and tapes out of the dirt when possible. Clean them when necessary. Metal joints on wood rules should be cleaned and lightly oiled as often as necessary to prevent rust and stiff operation which eventually might snap the rule.
• Dividers (1)		
· Types (1)		Another name for dividers is compass. Dividers are differentiated by size and type of marking. Most dividers have sharpened points which scribe circles or arcs.
· Uses (1)		Dividers are used to do the following: • Bisect angles and line segments • Erect perpendicular line segments • Divide line segments into equal parts • Pick up measurements and transfer them provided the setting is not changed
· Care and Maintenance (1)		Dividers are a precision instrument. They should be kept clean and rust free and stored where they will not be bent or otherwise damaged.
Use and Care of Squares (2)		
• Types (2)		Squares are used to lay out and test angles. Common types of squares include the following: • Carpenter's squares have two metal legs forming a right angle, 24 by 16 inches or 24 by 18 inches. The long leg is called the body and the shorter leg is called the tongue. Both the tongue and the body can be used as rules or straight edges. Carpenter's or framing squares sometimes have tables used for framing printed on the legs.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Types (2)		• Try squares have two parts joined at right angles, namely, a thick wooden or metal stock and a thin steel blade which may be 2 to 12 inches long. Try squares are used constantly to test right angles after wood has been sawed. Adjustable try squares have a movable stock which locks anywhere on the blade. Try and mitre squares have a beveled corner adjacent to the blade which is used to try out or measure 45° angles. • Sliding T bevels are used for laying out or testing bevels and angles. The blade is adjustable and can be set to any angle.
• Use (2)		To test whether or not a board was cut at right angles, set the square with the stock on the working or reference surface, with the blade on edge over the cut surface. If light shows underneath the blade, the cut surface is not true. To lay out a line with a try square, determine which surface is to be the working surface. Set the blade flat on the surface on which the line is to be drawn, and bring the stock flat against the working surface. Hold the stock flat against one surface and mark with a pencil or knife blade tip for fine work in the other.
• Care and Maintenance (2)		Care and maintenance for squares is common sense. Do not bend or chip them. Keep them clean and rust free so that they are easy to handle and read. Oil the locking mechanism and groove of adjustable try squares occasionally.
Use and Care of Gauges (3)		
• Gauging (3)		Gauging is the marking, on wood, of lines parallel to an edge, end, or surface. A not too accurate line can be drawn less than 1 inch from an edge using a pencil, held between the thumb and index finger at an agle of 30° to the surface of the wood, and using the second finger as a guide along the edge of the wood.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Types (3)		A marking gauge is used to mark an accurate line parallel to an edge, up to 8 inches away from it. Made of either wood or steel, the gauge consists of a beam with a short pin or spur in one end, and an adjustable head which can be locked anywhere along the beam with a thumbscrew. A mortise gauge has an extra adjustable spur which enables a workman to mark two parallel lines simultaneously.
• Use (3)		Always set the gauge with a rule, not using the scale on the beam, since the spur at the end of the beam may have worked loose or be bent. Tighten the thumbscrew to lock the head. To draw the line, grasp the head and the beam, and, holding the head against the edge of the plank, push the gauge away from you.
• Care and Maintenance (3)		Care and maintenance procedures are basically the same as for rules and try squares. Keep the spur sharp, and be sure that it projects no more than one-sixteenth of an inch from the beam.
Care and Use of Levels (4)		
• Description (4)		The level has a wood, aluminum,or steel frame in which sealed glass tubes containing liquid are mounted. It is used to test surfaces for vertical and horizontal trueness. Each of the tubes mounted in the frame and containing liquid and an air bubble is called a glass.
• Use (4)		To check a plank for vertical or horizontal trueness, place the level on the surface you wish to check. A true surface will cause the bubble to rest exactly between the lines on the glass. It is difficult to get an accurate reading when the level is on an irregular surface. Consequently, the level is used to best advantage on smooth surfaces.
• Care and Maintenance (4)		When using a level, do not bend or damage the frame, since it will affect its accuracy. Keep the level clean, especially the glasses, so that the bubbles are readily visible. Store the level where it will not get knocked around or damaged.

MEASURING AND LAYOUT TOOLS: FEELER GAUGE, MICROMETER, TORQUE WRENCH

Identifies and explains the correct procedures for use and care of feeler gauges, micrometers, and torque wrenches

OBJECTIVES

At the completion of this module students will be able to:

1 *Identify types of and explain and demonstrate the correct procedures for the use and care of feeler gauges*

2 *Identify types and parts of and explain and demonstrate the correct procedures for the use and care of micrometers*

3 *Identify types and parts of and explain and demonstrate the correct procedures for the use and care of dial indicators*

4 *Identify types and parts of and demonstrate the correct procedures for the use and care of torque wrenches*

REFERENCES

(A) General Motors Corporation. *ABC's of hand tools.* Detroit, Mich. The Corporation. 1945.

(B) Stockel, M.W. *Auto service and repair.* Homewood, Ill. Goodheart Willcox Co., Inc. 1969.

(C) Whitt, Donald. *ed. Basic automotive tools and how to use them.* Los Angeles, Calif. Petersen Publishing Co. 1974.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Use and Care of Feeler Gauges (1)	*Devise practical situations that require the use of metalworking measuring and layout tools which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs.* (Ref. A; pp. 36-38; Ref. B, pp. 2-10)
• Types (1)	*During the practice periods, check carefully the measurements made by students and help them get the correct feel for properly set clearances.*

BACKGROUND INFORMATION

Feeler gauges measure space or clearance, in thousandths of an inch. They consist of several long thin blades marked in thousandths of an inch. Larger gauges range from one-or two-thousandths of an inch to 35-or 40-thousandths of an inch.

A special type of feeler gauge is the "stepped" feeler gauge, or the "go-no go" feeler gauge. The blades on such a gauge have a tip which is two-thousandths of an inch smaller than the rest of the blade. These gauges are especially useful in adjusting valve clearances.

The wire gauge is another type of thickness gauge which measures gaps with wires of varying diameters instead of with steel blades.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Use (1)		Using a feeler gauge accurately takes practice. Properly adjusted clearances should exert a light drag on both sides of the blade which specifications call for. A stepped feeler gauge blade should slide through properly adjusted clearance, until the step is reached. If the tip does not easily slide through, there is not enough clearance. If the tip and the rest of the blade slide through there is too much clearance. A wire gauge will measure a clearance only the diameter of the wire and cannot be counted upon to accurately measure clearances which extend over a wide area. A wire gauge is most commonly used, therefore, to measure plug gap, point gap, etc. Since the wire is round, a wire gauge can be used in a greater variety of positions than can a feeler gauge. The wire stated in the specifications should drag lightly on both surfaces of the clearance much the same as a feeler gauge. Never use a dirty feeler gauge because it will give inaccurate readings and contaminate working surfaces. Never use a greasy or oily feeler gauge to set points because current cannot pass through grease. Always use a feeler gauge that is flat and not bent or twisted. Never exert force on a feeler gauge.
• Care and Maintenance (1)		Feeler gauges should be kept clean and rust-free. If you must use oil to prevent rust, which is a prime enemy of feeler gauges, wipe the blade clean of oil before use. Store feeler gauges in a clean, dry part of a tool chest where they will not get knocked around.
Use and Care of Micrometers (2)		
• Types (2)	Review any mathematical concepts and operations necessary for the accurate	Two common types of micrometers are inside micrometers which are used to measure inside diameters and outside micrometers which are used to measure outside diameters. Common micrometers read in

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CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Types (2) (cont'd)	reading of a micrometer. (Ref. A, pp. 40-42; Ref. B, p. 2-10)	thousandths of an inch. Micrometers with a vernier scale read in ten thousandths of an inch.
• Parts (2)		Parts of an outside micrometer are the anvil, frame, spindle, hub, screw nut, thimble, compression nut, and cap. Clearances are measured between the spindle and the anvil.
• Use (2)		To use the micrometer, grasp the thimble between the thumb and forefinger, resting the frame on the palm of the hand. Screw the spindle down until the spindle and the anvil barely touch the surfaces of the object being measured. DO NOT SCREW THE THIMBLE DOWN TIGHT BECAUSE THIS WILL RUIN THE MICROMETER.
• Reading (2)		To read a micrometer, look at the hub. Each line on the hub represents 25 thousandths of an inch. Every fourth line which is numbered in sequence, represents 100 thousandths of an inch. Count the marks down toward the cap from the last number seen on the hub. Now, find which number on the thimble lines up with the long line on the hub which runs up to, and under the thimble. Add that number to the thimble reading. If the micrometer has a vernier scale, and none of the thimble lines and numbers lines up with the hub line, add the thimble number which is just under the hub line, to the number beside whichever two lines meet on the vernier scale. The following is an example. Adjust the micrometer properly on a piece of round stock. Exposed on the hub are two lines and a little space past the number 2 on the thimble. The number 2, plus two lines equals 250 thousands of an inch. On the thimble the number 23 is just below the long line on the hub which runs up to the thimble. The stock measures 273 thousands of an inch (.250 + .023), plus a little extra. On the vernier scale, which is also on the hub, the left hand number beside the two lines which meet, is a two. The diameter of the stock is .2732 two thousand, seven hundred thirty two ten thousandths of an inch, (.250 + .023 + .0002 = .2732). Practice using the micrometer until its use becomes automatic. Do not twist the thimble before a reading is taken or the process will have to be started all over again. The inside micrometer is read in the same manner.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Care and Maintenance (2)		The micrometer is a very delicate measuring instrument. It should be kept in a case when not in use. Use a micrometer on clean work with clean hands. Clean the micrometer with a soft cloth slightly moistened with a top grade light machine oil.
Use and Care of Dial Indicators (3)		Dial indicators are used to measure runout, end play, back lash, and out of roundness.
• Types and Parts (3)		Dial indicators consist of a dial scale usually reading in thousandths of an inch, a pointer, a contact point or indicator rod, and a strand or pedestal. Special indicators such as those used to check cylinder out of roundness come with special equipment.
• Use (torque wrenches)		There are three basic types of torque wrenches, namely, the dial indicating type, the deflecting beam type, and the audible click type, Torque wrenches are made to measure foot pounds, inch pounds, and their metric equivalents. To measure accurately, all torque wrenches must be operated with a smooth, steady force. Use a torque wrench such that the required torque is greater than 10 percent of the range and less than 90 percent. Bolt threads should be free of rust, paint, nicks, and burrs and should usually be lubricated before they are torqued. Follow the manufacturer's recommendations when tightening bolts in sequence, such as cylinder head bolts. To recheck the torque exerted on a fastener, loosen the torqued fastener. The "break away" torque will generally be about 10 percent greater than the specified torque for standard fasteners. Loosen the fastener one-half to one turn and retighten to specifications.

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CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Use (torque wrenches) (3) (cont'd)		Do not use a ratchet head torque wrench or any other torque wrench for normal assembly and disassembly work. Use the wrench only when necessary.
• Use (dial indicators)		Mount the indicator securely on the stand so that the indicator rod is exactly parallel to the expected line of movement to be measured. Move the indicator far enough toward the work so that the dial movement in either direction of the dial starting point can be read. Turn the measured object slowly enough to read the outer limits of dial movement on either side of the starting point. Subtract the smaller limit from the larger limit to compute the amount of movement, out of roundness, or runout. It is a good idea to double check the first readings.
• Care and Maintenance (3)		Basically the care and maintenance is the same as for any other precision measuring instrument.
Use and Care of Torque Wrenches (4)		
• Types and Parts (4)		Torque wrenches are used in machine assembly to measure the amount of twisting force or torque exerted on a fastener. Using a torque wrench improperly can result in mechanical failure of both wrench and fastener.
• Adapters (4)		Changing the effective length of a torque wrench will affect its ability to exert force, without changing the indicator reading. A vertical extension does not change the effective length of the wrench so does not present any particular problem.
	Show how to find the actual force exerted on a fastener when a horizontal extension is used on a torque wrench. (Ref. C, pp. 26-37)	To determine the actual force exerted on a fastener by a torque wrench and a horizontal extension, use the following formula: $$TW = \frac{TA \times L}{L + A}$$

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
	Use problems to give students the opportunity to work with the formula in relation to their individual occupational needs.	where TW is the indicated value on the wrench, TA is the actual torque value applied to the fastener, L is the lever or wrench length, and A is the attachment length. Where the use of the horizontal extension shortens the effective length of the torque wrench, use the following formula: $$TW = \frac{TA \times L}{L - A}$$ Always measure L in a straight line, from your thumb on the wrench handle to the center of the bolt bead or nut in the adapter. Never overload a torque wrench by placing a pipe or extension bar over the handle and applying force. Doing so will probably permanently damage the deflecting element.
• Care and Maintenance (4)		Keep the torque wrench clean. Do not drop it or slam it around. Store it in a place where it will not be knocked about with your other tools. The torque wrench is a precision measuring instrument and deserves special care.

CUTTING AND SHAPING TOOLS

HAND SAWS (WOOD)

Identifies types and parts of wood cutting hand saws and explains how to use them safely and efficiently

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various types and parts of hand saws*

2 *Explain and demonstrate the safe and efficient use of various types of saws*

3 *Explain and demonstrate correct care and maintenance procedures for various types of saws*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Parts (1)	*Students should become proficient at using a crosscut and rip saw. Practice under supervision may be necessary to correct bad habits in sawing that students may have acquired previously.* *Develop practical situations that require the use of hand saws which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs.* (Ref. A, pp. 24-33)	Parts of a common crosscut or rip saw are: handle; butt—the area of the blade near the handle; toothed edge, which does the cutting; the back—the other long edge of the blade; and the point or end of the blade opposite the butt. Generally, the fewer the number of teeth per inch, the faster but rougher the cut. The kerf is the slot which the saw forms when it cuts. The set is the angle of the saw teeth relative to the plane of the saw blade. The greater the set, the wider the kerf.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Types (1)	*If many of the students are in the wood trades they should learn how to use the saws listed.* *During the practice periods, supervise the students carefully to see that they are using the correct procedures.*	Saws vary in their size and number, design, and arrangement of their teeth. Some of the more common saws are listed below: • Rip saw — use for cutting with the wood grain, usually along the length of a plank. • Crosscut saw — used for cutting across the grain. Crosscut teeth have more set than do rip saw teeth. • Back saw — similar to but smaller than a mitre box saw and used for fine work and cabinet making. • Mitre box saw — a type of back saw with fine teeth and used with a mitre box to make joints and angles. • Dovetail saw — smallest back saw and used for dovetailing and model making. • Keyhole saw — a saw with a narrow pointed blade used to cut curves and patterns starting from a drilled hole. • Compass saw — similar to but larger than a keyhole saw. • Coping saw — a thin saw which looks like a cake cutter and usually has an adjustable blade; used to cut patterns in thin wood.
Use (2)		
• Marking the cut (2)		Use a pencil and a try square or sliding T-Bevel for marking out rough cuts. Do not saw directly on the line but slightly to the "waste" side of it. Remember, it is easier to plane or cut off the excess wood than it is to put on wood which should not have been cut off.
• Sawing (2)		Start the cut or kerf on the "waste" side of the line by drawing the saw up as many times as necessary to get the cut started, while holding the plank with your other hand next to the kerf. Guide the saw with the tip or first joint of your thumb being careful not to cut yourself. A crosscut saw should be held so that the blade makes a 45° angle with the plank. For a ripsaw the angle is 60°. Saw slowly and evenly, remembering that the saw cuts only on the downward stroke. Check that the plane of the saw is perpendicular to the plane of the wood with a try square from time to time.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Hints (2)		Wood to be sawed should be held firmly in a vise or on sawhorses. If supported on sawhorses, hold the wood firmly with one knee. As the cut is finished, support the waste end of the wood with a free hand, or have someone support the waste end. This will help prevent binding and large splinters which occur if the waste end is allowed to fall unsupported.
Care and Maintenance (3)	If it becomes important to teach saw sharpening, it may be necessary to invite an expert on the topic to present the information to the students. One or two class periods may be required for this activity.	A saw is a cutting tool which must be kept sharp. To help keep a saw sharp, handle it carefully. Hang it up in a dry place when not in use. If rust spots appear on a saw blade, rub them off with emery cloth and lightly oil the blade. Unless a person uses hand saws regularly and has a number of them he may be better off having his saws sharpened and set by a professional. This will save time and help keep the saws in good condition. If a person really wants to learn how to sharpen saws, he should practice filing. If he can file accurately, saw sharpening is not very difficult.

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PLANES

Identifies parts and types of planes and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various types and parts of planes*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

OBJECTIVES

2 *Explain and demonstrate the safe and efficient use of various types of planes*

3 *Explain and demonstrate correct care and maintenance procedures for planes*

REFERENCES

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Parts (1)	*Develop practical situations that require the use of planes which will give students an opportunity to improve their proficiency using ~~these~~ tools in relation to their individual occupational needs (Ref. A, pp. 52-62, 93-94)*	A plane is a cutting and smoothing tool used on wood surfaces. It has the following parts: the blade assembly consisting of the cap, cap iron, plane blade, and cap iron screw; the cap lever screw; the hand knob at the front or toe of the plane; the slot or mouth in the sole or middle section of the plane; the heel section; the mouth width adjusting screw; the blade thumbscrew; the hand grip; the lateral adjustment lever; the frog assembly and the Y lever which moves the blade.
Types (1)	*During the practice periods, supervise the students carefully to see that they are using the correct procedures.*	The three common types of planes are: • Block plane, the smallest of the common planes, • Smoothing plane • Jack plane, the largest of the common planes. Other less common types are the rabbet and cabinetmaker's planes, low angle planes, circular planes, and scrub planes.
Use (2)		
• Adjustments (2)		There are three types of adjustments possible on most planes. The mouth width is adjusted by turning the frog set screw to make the mouth wider for deep cuts in soft woods or narrower for cuts in hard, cross-grained woods. The lateral adjustment lever moves the plane blade or iron and is adjusted to project an even blade edge from under the cap iron and cap. The blade should always project an even edge.

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CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
		The vertical adjustment regulates the depth of the cut measured by the thickness of the shaving produced. Most beginners adjust the blade so that it projects too far below the sole.
• Holding Work (2)		The work to be planed should be clamped securely in a vise because accurate plane work requires two hands and a stationary surface.
• Gripping Plane (2)		The block plane is held in one hand by the thumb on one side, the index finger on the finger rest knob at the toe of the plane, and the other fingers gripping the side of the plane opposite the thumb. A right hander holds smoothing and jack planes with his right hand gripping the hand grip at the heel section of the plane, and his left hand gripping the hand knob with his thumb at the base of the knob.
• Basic Strokes (2)		Planing an even surface requires constant pressure through the entire stroke. To make an even cut from start to finish, apply pressure on the toe at the beginning of the stoke so that the sole of the plane stays parallel to the planed surface. At the finish, avoid going downward off the end of the board by applying more pressure on the heel of the plane.
• Hints (2)		If the plane roughens or tears the grain, reverse the plane's direction. As in chiseling, to avoid splits, especially when planing end grain, work from the edges toward the center, and then plane the center. To make a rough surface smooth, use a jack plane first, to ride over the low spots and cut the high spots. Finish the job with a smaller, smoother plane. To keep narrow edges square, grip a wood strip tightly to the sole of the plane to act as a guide.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
		A jack plane will rapidly cut the high spots or rounds off a wide rough plank if first guided diagonally across the plank. Finish off the plank with smooth straight strokes.
Care and Maintenance (3)		Lightly oil adjusting screws and assemblies occasionally. If rust appears on plane metal surfaces, remove it with emery cloth and lightly coat all exposed metal surfaces with oil. Store the plane in a dry area where it will not get banged around — possibly hanging on a rack. Always retract the blade from cutting position before storage. If it is necessary to set the plane aside while its blade is in cutting position, always lay the plane on its side. Remember, plane blades nick and dull easily. The less the blade is abused, the less it will have to be sharpened and replaced.
• Sharpening (3)		The plane iron requires two operations to sharpen — grinding and whetting. Grinding is not necessary unless the blade is nicked or very dull. Do not draw the temper out of the blade by prolonged grinding. The wheel should turn toward the body of the iron or away from the edge. Grind a bevel the length of which is twice the thickness of the blade, between 25-30°. Keep the cutting edge at right angles with the sides of the plane. Grind the blade from side to side until a wire edge appears. Measure the angle of the bevel frequently during grinding. Use an oilstone or whetstone to produce the final or whetted edge. The whetted bevel should be 30-35°. Keep constant pressure on the blade. Do not rock it. Turn the blade over so the flat side rests fully on the stone. If this does not remove the wire edge, turn the blade over once more and make a few light strokes on the whetted bevel.

Wood Chisels

Identifies parts and types of wood chisels and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various parts and types of wood chisels*

2 *Explain and demonstrate the safe and efficient use of various types of chisels*

3 *Explain and demonstrate correct care and maintenance procedures for wood chisels*

CONTENT	INSTRUCTIONAL SUGGESTIONS
Parts (1)	*Develop practical situations that require the use of wood chisels which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs.* (Ref. A, pp. 34-42)
Classes (1)	*During the practice periods, supervise the students carefully to see that they are using the correct procedures.*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

BACKGROUND INFORMATION

Wood chisels are used to cut and shape wood. Starting at the cutting end of the chisel, the parts are: the cutting edge; the bevel (the slanted portion of the blade which meets the cutting edge); the blade; the shank which connects the blade with the handle; the tang, which is part of the shank and fits inside the handle; the handle; and the ferrule, which is a metal or leather cap on the end of the handle to protect it from hammer or mallet blows.

Wood chisels are commonly divided into three basic classes which are differentiated by the construction of the handles.

A tang chisel handle holds a portion of the chisel shank called the tang. A tang chisel is used primarily for light work since heavy blows to this chisel handle will split it.

A socket chisel handle is wood, and slips into a socket in the chisel handle. These chisel handles are replaceable and their blades are thicker. Both these factors make socket chisels suitable for use with a heavy mallet.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
		An everlasting chisel is made from one piece of metal which forms a ferrule at the striking end of the chisel and goes through the handle to form the chisel shank and blade. This makes everlasting chisels suitable for use with a steel hammer instead of a mallet.
Other Types (1)		Wood chisels are further differentiated by their blade size and shape. Some of these chisels are: bevel edged chisels, paring chisels, firmer chisels, butt chisels, and mortise chisels.
Size (1)		Chisels come in sizes from 1/8" to 1" graduated by eighths and from 1" to 2" graduated by fourths.
Use (2)	Ask students to identify the direction of the grain on several pieces of wood.	Chisels are more efficiently used for finishing purposes only. Other tools such as planes, saws, and augers should be used as extensively as possible before chiseling starts.
	Under certain circumstances it may be appropriate to teach the different types of chisel cuts more thoroughly. (Ref. A, pp. 34-42, 83-87)	Select the proper chisel for the job. Do not use a steel hammer on any chisels except the everlasting type.
		For rough work, use a hammer. For fine work, use one hand for driving power and control and the other hand almost entirely for control.
		Secure the work tightly so it cannot move. Always cut away from the body and always keep both hands in back of the cutting edge at all times.
		Always start a cut slightly toward the waste side of the guideline, as in sawing. On horizontal cuts, make shavings thin and cut with the wood grain. This should reduce splitting. Make vertical cuts across the grain.
		Paring is cutting fine shavings with the grain with a shearing cut, achieved by slanting the chisel slightly in the direction of the cut and guiding the chisel slightly diagonally across the work.
		For rough cuts use the chisel bevel side down. For fine and finishing work use it bevel side up. Do not chisel horizontally across the grain, since the chisel will become difficult to control and possibly split the wood.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
		Other types of cuts include horizontal cuts across the grain, vertical cuts with and across the grain, and cutting curves, diagonals, and camfers. The same general rules apply to these types of cuts. Work slowly, making small shavings. Finish the cuts in a waste area instead of towards a "kept" edge. Use the chisel with a shearing motion whenever possible.
Care and Maintenance (3)		Wood chisels are cutting tools. To preserve their edges, store them in a rack where the edges cannot contact metal. Replace handles on socket chisels when they crack or split. If chisels begin to rust, remove the rust with emery cloth and coat the blades lightly with oil.
• Sharpening (3)	*Under certain circumstances it may be appropriate to spend a class period exclusively sharpening chisels and possibly knives.*	Grind a chisel blade only when it becomes nicked. When grinding, wear safety glasses. For regular sharpening, use an oilstone having a coarse and a fine surface. Keep the stone surface coated with light machine oil or kerosene. A chisel has two bevels — a large one used for rough cuts and a smaller one used for fine cuts. The large bevel is ground on a wheel if badly nicked, or if not, on the coarse side of an oil stone. The small bevel is ground on the fine side of an oilstone. Rub the fine bevel of the chisel with smooth, even, light strokes. Remove the burr by whetting the chisel flat side down for two or three light strokes and then turning the chisel over bevel side down and taking two or three light strokes.

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HACKSAWS

Identifies types and parts of hacksaws and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various types and parts of hacksaws and blades*

2 *Explain and demonstrate the safe and efficient use of hacksaws*

3 *Explain and demonstrate correct care and maintenance techniques for hacksaws*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

(B) Whitt, Donald, *ed. Basic automotive tools and how to use them.* Los Angeles, Calif. Peterson Publishing Co. 1974.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Parts (1)	*Develop practical situations that require the use of hacksaws which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs.* (Ref. A, pp. 118-121; Ref. B, pp. 66-71)	A hacksaw consists of a handle, either closed or open; a frame, adjustable or non-adjustable; stretchers on which the blade is mounted; and a wingnut to tighten the blade.
Blades (1)	*During the practice periods, supervise the students carefully to see that they are using the correct procedures.*	
• Types (1)		Hacksaw blades vary by number and arrangement of teeth. Blades may have coarse or fine teeth. Usually, the finer the teeth, the greater the number of teeth per inch. A standard coarse-toothed blade has set teeth for a wide kerf. A wave-fine tooth blade has, as the name suggests, a blade with a slight wave in it. A wide kerf helps prevent binding of the blade while it cuts. Most blades are tempered to give them long life. The temper also makes them impossible to sharpen.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Selection (2)		The general rule for blade selection is that at least two, and preferably three, teeth should be in contact with the material being cut at all times. Therefore, to cut a narrow piece of metal, you should select a blade with a high number of teeth per inch.
• Fitting (2)		Remove the old blade from the hacksaw frame by loosening the wingnut and removing the blade from the stretcher pins. Adjust the frame to the length of the blade if the frame is adjustable. Fit the new blade on the pins. Pull the blade back toward the handle and tighten the wingnut. Check that the blade is straight in the frame. If it is not straight, loosen the wingnut, straighten the blade and retighten the wingnut. Be sure blade teeth face away from the handle.
Starting the Cut (2)		Hacksaws will not cut most tempered steels. To find out if the material you wish to cut can be cut with a hacksaw, test it with a file first. If the file cannot cut the material, the hacksaw cannot. Make sure the material is securely clamped in place. Start the saw flat, so that two or more teeth contact the material being cut at all times. Guide the top edge of the blade with the thumb until the cut is well-established. Remember that the blade cuts on the forward stroke only, so lift the saw slightly on each return stroke. The stroke should be long and steady, about 40-50 strokes per minute, and should use practically all the teeth on the hacksaw blade. Light pressure should be used on soft or thin metal and heavier pressure on harder thicker metal. Too light pressure will dull the teeth, too heavy pressure will cause the blade to wobble in the cut and possibly break. Use oil or cutting fluid to aid cutting.
Common Errors (2)		The following are mistakes commonly made by persons using hacksaws: • Broken blades caused by too much or too little tension, too much pressure on the blade, frame twisting while cutting, or blade teeth too coarse. • Broken or stripped teeth caused by too much pressure on the blade, cut started on edge or at an angle, or too coarse teeth.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
		• Dull teeth caused by cutting at too high a speed, saw not lifted on back stroke, improper blade selection, teeth pointing toward instead of away from handle, or pressure too light. • Crooked cut caused by dull blade, blade needs tightening, frame out of alignment, or crooked sawing.
Hints (2)	Ask students to suggest ways of cutting wide pieces of sheet metal.	A new blade makes a wider kerf than an old blade. If a blade breaks, start a new cut opposite the old one if possible, If you cannot start a new cut, work the new blade gradually into the old cut. To cut bolts, screw the nut down on the threads which will remain after the cut. Then unscrew the nut to straighten out any threads burred or damaged by the saw. A hacksaw may be used to make or enlarge slots in screws or studs. Blades come in different thicknesses. Thin metal in a vise can be cut more easily if two scrap blocks of wood are placed in the vise on either side of the metal. Cut through the metal and the blocks. This helps to prevent the metal bending or vibrating.
Care and Maintenance (3)		A hacksaw should be hung on a hook or nail. Blades should not be allowed to rub directly on other objects. If blades are to be stored, lightly oil them to prevent rust and wrap them in cloth to protect the teeth.

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COLD CHISELS

Identifies types of cold chisels and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various types of cold chisels*

2 *Explain and demonstrate the safe and efficient use of various types of cold chisels*

3 *Explain and demonstrate correct care and maintenance procedures for cold chisels*

REFERENCES

(A) Whitt, Donald, *ed. Basic automotive tools and how to use them.* Los Angeles, Calif. Petersen Publishing Co., Inc. 1974.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Types (1) • Flat Chisel (1) • Side Chisel (1) • Cape Chisel (1) • Diamond Point Chisel (1) • Round Nose Chisel (1)	*Develop practical situations that require the use of cold chisels which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs. (Ref. A, pp. 164-169)* *During the practice periods, supervise the students carefully to see that they are using the correct procedures.*

BACKGROUND INFORMATION

The term cold chisel is a general term covering any chisel designed to cut, shear, or chip cold metal. Most cold chisels have a common shape. They differ in their blade size and design.

The flat chisel is used for general cutting and chipping work. The cutting edge consists of one bevel on either side of the blade, forming an angle of 60° to 70°.

The side chisel is like the flat chisel except that its blade is beveled on one side only. This chisel is used to make slots and grooves.

The cape chisel has a very narrow cutting point used for cutting narrow grooves in metal.

The diamond point chisel is so-called because of its diamond shaped point, which is useful for chipping out V-grooves and for cleaning out square corners of metal.

The round nose chisel has a round nose point with a bevel and is used for cutting oval-shaped grooves in metal.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Use (2)		
• General (2)		Always wear safety glasses when using a cold chisel. Do not use a cold chisel in a location or manner which will endanger other people in the area. Select the proper cold chisel for the job. Select the proper hammer, the face diameter of which should be no larger than twice the diameter of the chisel. Hold the chisel near the head and the hammer at the end of the handle. Watch the cutting edge of the chisel, not the chisel head. Strike the chisel squarely to avoid damaged work or a mashed hand or both. Be sure the cutting edge of the chisel is at the right angle for the work and will not gouge or glance off the material. Recheck the angle after each hammer blow. Never use a chisel which is dull or has a "mushroomed" head. It may be possible to use a chisel holder on some jobs which do not require a high degree of precision and thereby save the hands and knuckles.
• Cutting Sheet Metal (2)		To shear sheet metal, place the metal in a vise with the waste edge exposed at the top and the vise jaws just covering the cutting. line. Place the chisel on the jaws of the vise at an angle to the material which is to be cut. When cutting, check the chisel angle frequently. If the chisel shank is held too close to the vise, the shearing action of the vise and the chisel will be lost. Too high an angle will damage the chisel on the vise. To cut flat metal, lay the metal on a soft metal plate. Lightly tapping the chisel with the hammer, indent the layout line. Then use heavier blows to cut out the indented outline from the waste material.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Care and Maintenance (3)		Keep the cold chisel clean and free of grease or oil. Wipe it before placing it in the tool tray. When a chisel becomes damaged or dull, it should be dressed or sharpened and returned to its original shape. This is done on a grinding wheel. Use a medium or fine grit grinding wheel. Grind for short periods of time only, quenching the warm chisel end frequently to keep it cool. Metal which gets too hot turns blue and loses its temper. Continue grinding for short periods until all chips, cracks, and gouges are removed from the head. Grind the cutting edge so that the wheel rotation is away from the cutting edge, toward the body of the tool. Check the blade frequently to make certain that the edge is being ground to the proper angle.

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FILES

Identifies parts and types of files and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various parts and types of files*

2 *Explain and demonstrate the safe and efficient use of various types of files*

3 *Explain and demonstrate correct care and maintenance procedures for files*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Parts (1)	*Develop practical situations that require the use of files which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs.* (Ref. A, pp. 104-109)	Files are basic metalworking tools used for cutting and shaping metal. Files have the following parts: the handle; the tang which fits into a handle; the heel which is the toothless part of the file connecting the tang with the teeth; the face or cutting surface of the file; the tip which is the front portion of the face; and the edge which is the edge of the face. The length of a file is measured from the tip to the outer edge of the heel.
Types (1)	*During the practice periods, supervise the students carefully to see that they are using the correct procedures.*	Files are differentiated by the arrangement of teeth, number of teeth per inch, design of the teeth, and the cross section and length of the file. Two common tooth arrangements of files are the single cut used for lathe and finishing work where a smooth finish is desired and the double cut which cuts faster than the single cut but which leaves a rougher surface. There are also the rasp cut used for wood or soft materials and the curve tooth used in sheet metal work to remove large amounts of metal rapidly. Single cut and double cut files come in four basic grades, namely, coarse, bastard, second cut, and smooth. File faces are made in different shapes and cross sections. Some of the more common are: flat, square, triangle, cantsaw, crosscut, round, half round, rat tail, knife, and three square. Each shape or cross section is well suited for a particular function or set of functions such as filing round holes, notches, and cleaning threads.
Use (2)	*Filing is a basic hand tool skill. Students may need to practice filing under supervision to develop the desired proficiency in relation to their individual occupational needs.*	Never use a file without a handle. The tang is sharp and can easily pierce the palm of the hand. Insert the file tang into the handle and strike the handle solidly on the workbench surface to wedge the tang in. Accurate filing takes two hands. The work must therefore be held rigidly. Use vise jaw caps to prevent marring of smooth surfaces.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Selecting File (2)		In general, select a double cut, flat file for rough work and a single cut file for finishing work. Extra soft materials which clog ordinary file teeth may require special files.
• Holding File (2)		Right handed people should hold the file handle end against the palm of their right hand with the thumb extended along the top of the handle and the index finger extended along the side. The position of the left hand changes according to the type of filing done. For rough filing, grip the tip of the file from the top with a clenched fist. For more accurate filing, grip the tip of the file with the thumb and index finger with the other four fingers resting on the under face of the file. Alternatively, spread the thumb and first two fingers and rest the thumb on the middle of the face and the first two fingers on the tip.
• Using file (2)		Bear down only on the forward or cutting stroke, except when filing soft materials which will clog the file teeth. Pressure on the back stroke when filing hard materials will dull the file teeth. Do not rock the file when filing a flat surface. Finish a surface with draw strokes and rub the surface with emery or crocus cloth. Check frequently with a straight edge or try square to see that flat surfaces are maintained on the work.
Care and Maintenance (3)		Files which have been used to cut hard metals will not cut soft metals efficiently. Therefore, use new files on soft metals during the first part of their lives. A file card is a wire brush used to clean metal particles out of file teeth. Draw the file card across the face of the file, back and forth along the direction of the teeth. Store files in a dry place to avoid rust, which dulls file teeth. Hang files in a rack to prevent injury to the teeth and to make identification and selection easier. Because files tend to be brittle, they should not be dropped or used for any purposes beside filing.

HOLDING AND FASTENING TOOLS

WRENCHES

Identifies various types of wrenches and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various types of solid, nonadjustable wrenches and explain and demonstrate their safe use and maintenance*

2 *Identify various types of adjustable wrenches, and explain and demonstrate their safe use and maintenance*

REFERENCES

(A) Stockel, M.W. *Auto service and repair.* South Holland, Ill. Goodheart-Willcox Co., Inc. 1975.

(B) Whitt, Donald, *ed. Basic automotive tools and how to use them.* Los Angeles, Calif. Petersen Publishing Co., Inc. 1974.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
	This module should be flexible. If other tools would be more appropriate than the ones presented, include them at the proper place in the sequence. Identify them and explain their use, care, and maintenance.	
	Give anecdotes and tips about the various tools to emphasize points relative to their use and maintenance.	
	Have the actual tools being discussed in class available for reference to their specific parts and use.	

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Nonadjustable Wrenches (1)	*Develop practical situations that require use of wrenches which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs. (Ref. A; Ref. B, pp. 130-143)* *During the practice periods, supervise the students carefully to see that they are using the correct procedures.*	Open end wrenches are among the most commonly used wrenches and are used on nuts, bolts, and cap screws. Other types of the solid, open end wrenches are flare nut, ignition, and tappet wrenches. Closed or box end wrenches grip a nut or bolt head on all sides and are therefore less likely to slip. Box wrenches may have six or twelve point openings. Combination box and open end wrenches have a box end and an open end. The most common type of set screw wrench is the hexagonal Allen wrench.
• Use (1)		Although there are different types of nonadjustable wrenches the following basic principles of use apply to all of them: • Select the right wrench for the job. Use a box end for breaking nuts loose and tightening them down. • Keep hands free from grease so they do not slip off the wrench. • Position feet firmly to keep from falling if the wrench slips. • Whenever possible use a pulling motion with a wrench. If it is necessary to push the wrench, open the hand so as not to skin the knuckles if the wrench slips. • In close quarters, turnover an angled open end wrench after each movement to get a greater number of degrees of turning. • Never strike an open end or box end wrench with a hammer or try to get extra leverage by slipping a piece of pipe over the end. The wrench may be destroyed as well as the fastener being loosened.
• Care and Maintenance (1)		Wipe wrenches off at the end of the day before returning them to the tool box. Give wrenches a solvent bath when they get dirty.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Adjustable Wrenches (2)		
• Types (2)		There are two common types of adjustable wrenches — the crescent wrench and the pipe wrench. Both types come in different lengths and sizes. The crescent wrench is basically an open end wrench with one movable jaw, used to turn nuts, bolts, and cap screws. The pipe wrench has "toothed" jaws to grip pipes, and irregular objects.
• Use (2)	Demonstrate how to use an adjustable end wrench. Show what happens when the pull is the wrong way and why it is also called a "knuckle buster."	Many of the same principles which apply to nonadjustable wrenches also apply to adjustable wrenches with this added factor — crescent wrenches, because they have a movable jaw, are much more likely to slip. Consider the following when using adjustable wrenches: • Never use a crescent wrench in place of a nonadjustable wrench. • If it is necessary to pull hard, pull toward the movable jaw so that the greatest force is exerted on the fixed jaw. • Before pulling, be sure that the movable jaw is snugged as tightly as possible against the fastener. • Never use a pipe wrench on a fastener unless the fastener is already useless and using the pipe wrench is the only way to loosen the fastener.
• Care and Maintenance (2)		Inspect adjustable wrenches occasionally for excessive jaw play, proper operation of the knurled nut, and cracks. Wipe wrenches off daily and give them a solvent bath when necessary. Put a few drops of oil on the knurled nut mechanism occasionally.

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Sockets, Socket Handles, and Attachments

Identifies various types of sockets, socket handles, and attachments and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various types of sockets*

2 *Identify various types of socket handles and socket attachments*

3 *Explain and demonstrate safe and efficient work practices with, and care and maintenance of sockets, socket handles, and attachments*

REFERENCES

(A) Stockel, M.W. *Auto service and repair.* South Holland, Ill. Goodheart-Willcox Co., Inc. 1975.

(B) Whitt, Donald, *ed. Basic automotive tools and how to use them.* Los Angeles, Calif. Petersen Publishing Co., Inc. 1974.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Types of Sockets (1)	*Develop practical situations that require the use of sockets which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs.* (Ref. A; Ref. B, pp. 116-130)	Sockets are identified by the following: • Deep or standard • Four, six, eight, or 12 points with six and twelve points being the most common. • Size fastener which the socket fits which may be metric or standard. • Size of the handle end which fits into the socket, commonly 1/4", 3/8", or 1/2". • Universal or nonuniversal socket. Each of the above factors can be found with any other factor. Other types of sockets which can be mounted on socket handles have screwdriver heads of different types, magnetic heads, allen heads, and special rubber inserts for spark plugs.
	During the practice periods, supervise the students carefully to see that they are using correct procedures.	
Handles (2)		Common socket handles have reversible ratchets which come with 1/4" to 1" drives, with 1/4" and 3/8" being commonly used. Generally, the more clicks the ratchet handle makes per revolution, the more useful the handle will be where swing area is limited. Better socket handles have a quick socket release feature.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Handles (2) (cont'd)		Other useful types of socket handles include the plastic-handle driver with solid or flexible shaft, the sliding "T" handle, the speed handl , and the hinged handle or breaker bar. Eacl one of these handles is used for a specific situation.
Attachments (2)		Socket attachments which are placed between the socket and the handle include the following: • Adapters which can match one socket drive with a handle of a different drive, either larger or smaller. • Universal joints which are usually used with extension bars to transfer the socket drive around an angle. • Extension bars which are often used to make work in tight places easier or possible, by allowing the socket handle to be worked in a larger swing area.
Use (3)		When using socket wrenches consider the following hints: • Select the right equipment for the job. • Be sure the hands and socket handle are not slippery. • Get a good footing. • Pull the handle whenever possible, especially when breaking a a fastener loose or tightening it down. If it is necessary to push the handle, do so with the palm of the hand and keep the hand open. • Never strike a ratchet handle with a hammer. It will destroy the ratcheting mechanism in the head. • When a lot of force is necessary to loosen a fastener, use a breaker bar.
Care and Maintenance (3)		Wipe dirt and grease from the sockets before storing them in a tool chest. This will help prevent wear and rust formation on the sockets and make their size more visible, which will speed up the work being done. Many workers store sockets in a tray, graduated by size, which helps them return the sockets to the same place after use and makes it easier to find them next time. It also helps workers to tell which sockets are missing. A socket set with pieces missing is frustrating to use.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Care and Maintenance (3) (cont'd)		Keep ratchet handles clean and as free from grease or oil as possible. Keep dirt out of the ratchet mechanism. Occasionally oil the mechanism. Some ratchet mechanisms can be removed from the head and cleaned. This is good practice because it usually improves the operation of the ratchet and prolongs its life.

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PLIERS AND WIRE CUTTERS

Identifies various types of pliers and wire cutters and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify and state the use of various types of pliers*

2 *Explain and demonstrate the safe and efficient use of various types of pliers*

3 *Explain and demonstrate correct care and maintenance practices for pliers*

REFERENCES

(A) Stockel, M.W. *Auto service and repair.* South Holland, Ill. Goodheart-Willcox Co., Inc. 1975.

(B) Whitt, Donald, *ed. Basic automotive tools and how to use them.* Los Angeles, Calif. Petersen Publishing Co., Inc. 1974.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Pliers (1)	*Develop practical situations that require the use of pliers which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs. (Ref. A; Ref. B, pp. 142-149)*	Pliers are generally used to bend, hold, twist, pull, or cut and fall into two categories: solid joint (nonadjustable) and slip joint (adjustable).
• Nonadjustable (1)		Nonadjustable pliers come in a wide variety of sizes and j w shapes useful for many different applications. Some of the more common types of solid joint pliers include the following:

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Nonadjustable (1) (cont'd)		• Needle-nosed pliers, either round or square jawed, are used most often in electrical work. Other types of solid joint pliers include duck-billed pliers, snap ring pliers, and brake spring pliers. • Solid joint diagonal cutting pliers are used for removing old cotter pins and trimming new ones. Other types of cutting pliers include compound leverage cutting pliers, side cutting pliers, end cutting pliers, and exhaust and tailpipe cutter pliers.
Adjustable (1)		Two common types of slip joint pliers are combination slip joint pliers, and interlocking slip joint pliers. Combination pliers consist of handles, toothed jaws, a sliding pivot, and a short shearing edge for cutting wire.
• Slip Joint (1)		Interlocking, or water pump pliers, are larger than combination pliers and their jaws can be opened to a number of wider positions. The jaws remain parallel for greater gripping power and the handles are longer for greater leverage.
• Vise-grip (1)		Vise-grip pliers lock or clamp on to any round or irregularly shaped object. Once locked, the handles need not be squeezed and the vise grips can be merely held in the hand. Vise-grips are useful for holding work while another operation is being performed on the work and for removing damaged studs and other fasteners. Vise-grips come in a wide variety of sizes and jaw shapes.
Use (2)		Always adjust the jaws so they stay as nearly parallel as possible and grip the object with as much of the jaws as possible. Never use pliers on any surface such as nickel or chrome without first padding the jaws with cardboard or tape. Never grip tubing so tightly as to crush it. Never use pliers to turn nuts and bolts because it will round off the corners and badly mar them. Never squeeze pliers with anything other than a hand.
• Vise-grip (2)		To use vise-grips pliers, grasp the work lightly in the jaws and turn the knob until there is resistance, then, squeeze the vise-grips until they lock. To release, squeeze the lever against the handle, being careful not to get pinched. Do not use vise-grips on material which will be destroyed or marred by the teeth in the jaws.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Solid Joint (2)		Do not attempt to bend or twist heavy material with the jaw ends of needle-nosed pliers. They will bend out of line. When working around electricity, use insulated pliers and caution. Do not use side cutters to cut piano wire or tempered steel because it will destroy the cutting surfaces. To remove insulation from wires with side cutters, crush the insulation with the flat part of the jaws, lightly grip the crushed insulation with cutting part of the jaws and gently rock and rotate pliers. As insulation is cut, gently pull sideways on the insulation to remove it.
Care and Maintenance (3)	Demonstrate how to sharpen pliers and side cutters.	Wipe pliers before placing them in the tool chest. Give them a solvent bath when they get dirty.
• Slip Joint (3)		In addition to the above procedures, slip joint pliers occasionally need their jaws adjusted. This is done by tightening or loosening the post nut on the side of the pliers and tapping the posts slightly with a center punch and hammer to lock the nut in place.
• Solid Joint (3)		Solid joint pliers need daily wiping and an occasional solvent bath. When the jaws of these pliers come loose, lay the fixed jaw, the one to which the rivet is firmly attached, on a flat surface such as an anvil and strike the rivet end in the movable jaw to expand it. Do not strike the rivet end with a punch or the peening end of a hammer. After each blow of the hammer check the pliers to determine if the sloppiness has gone out of the joint. The cutting edges of pliers or side cutters can be sharpened with a fine file or abrasive stone.

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SCREWDRIVERS

Identifies various types of screwdrivers and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various types of screwdrivers and their parts*

2 *Explain and demonstrate the safe and efficient use of various types of screwdrivers*

3 *Explain and demonstrate correct care and maintenance practices for screwdrivers*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

(B) Whitt, Donald, *ed. Basic automotive tools and how to use them.* Los Angeles, Calif. 1974.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Parts (1) Types (1) • Tips (1)	*Develop practical situations that require the use of screwdrivers which will give students an opportunity to improve their proficiency using these tools in relation to their occupational needs.* (Ref. A, pp. 14-22; Ref. B, pp. 38-43) *During the practice periods, supervise the students carefully to see that they are using the correct procedures.*
• Blades (1)	

BACKGROUND INFORMATION

The parts of a common screwdriver are the tip, which engages the screw head; the blade, which runs between the top and the shank; the shank, where the blade meets the handle; and the handle. Each of the parts can vary in size and shape among different screwdrivers, and can be found in different combinations.

Screwdrivers are identified by their tip types, blade lengths, shank shapes, and size.

Common tip types include the following:

- Standard or "slot" the most common type of tip used in most trades, and comes in a wide variety of sizes.
- Phillips, Reed and Prince, Clutch or Butterfly — common in automotive and machine trades.

Blades come in different shapes, thicknesses, and lengths. Commonly they are round and 4" to 6" long. Stubby screwdrivers have a very short blade. Heavy duty screwdrivers have thick blades that are sometimes square or hexagonal which can be turned with a wrench to give the user extra leverage.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Shanks (1)		Shanks may also be round, square, or hexagonal. Square or hexagonal shanks can be turned with wrenches.
• Handles (1)		Handles also come in a wide variety of sizes and designs. Large diameter handles can generally be used to exert more twisting force or torque than smaller handles.
• Offset (1)		Offset screwdrivers have a tip at either end which is offset. They are useful for work in tight places.
• Other (1)		There are also a variety of driving mechanisms to which detachable blades can be fitted. These include: ratchet, brace, and hand or electric drills.
Use (2)	Demonstrate how to drive screws into different types of wood and metal. *Provide practice periods and supervise students carefully to see that they are using the correct procedures.*	Safe and efficient use of screwdrivers should insure that the job gets done quickly without injury to the worker and without damage to the screw or the work. Be sure that hands and the screwdriver handle are not slippery. Select a screwdriver with a tip which fits the screw head snugly. If the tip is too big or too small, the screwdriver will strip the head and/or slip and possibly mar the adjacent surfaces. Generally, the longer the blade and the larger the handle, the easier the screw is to turn. Grip the handle firmly with the end in the palm of the hand. Use the other hand to steady the tip of the screwdriver in the slot. Always keep the screwdriver in the same vertical plane as the screw. To start a screw in wood, first make a pilot hold with an awl or a drill. In metal, use a center punch and follow up with a drill if necessary.
Hints (2)		When using screwdrivers consider the following hints: • Do not press down on a screwdriver if you are holding the work in your hand. The screwdriver could slip and pierce the hand. • Put some soap on the threads of a wood screw when it drives hard. For a machine screw, use oil or graphite.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Hints (2) (cont'd)		• When a screw cannot be loosened, try turning it clockwise a fraction of a turn, and then backing it out. If the screw stops part way out, partially retighten the screw then back it out. Repeat this performance until the screw is out. • Never use a screwdriver as a chisel or a pry bar.
Care and Maintenance (4)	Demonstrate how to reshape the tip of a screwdriver. *Obtain enough old screwdrivers for student practice following the demonstration. Carefully supervise students to see that they are using the correct procedures.*	Wipe a screwdriver before returning it to the tool chest for storage. Give it an occasional solvent bath to remove dirt and grease. Sharpening should be done only when the screwdriver tip is so badly worn that it is no longer usable. Always wear safety glasses when using the grinding wheel. Consider the following hints when sharpening a screwdriver tip: • Grind the end of the screwdriver to make a "flat" the width of the bottom of the screw slot. Remove as little metal from the screwdriver as possible during this and the following grinding operations. Cool the tip in water frequently to keep the temper in the metal. • Grind the edges of the tip to form a gradual taper, leaving the edge of the tip as long as the screw slot. • Grind both faces of the tip 1/4" up each side, keeping the faces as nearly parallel as possible. • Check frequently during these operations to determine whether or not the tip fits the slot of the screw.

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HAMMERS

Identifies various types of hammers and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify and explain the function of various types of carpenter's and machinist's hammers*

2 *Explain and demonstrate safe and efficient work practices when using carpenter's and machinist's hammers*

3 *Explain and demonstrate the correct care and maintenance practices for hammers*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

(B) Whitt, Donald, *ed. Basic automotive tools and how to use them.* Los Angeles, Calif. 1974.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Types and Parts (1)	*Develop practical situations that require the use of hammers which will give students an opportunity to improve their proficiency using these tools in relation to their occupational needs.* (Ref. A, pp. 4-13; Ref. B)	There are two types of common carpenter's hammers, namely, the claw and the ripping hammer. The claw hammer has a face and two curved claws for pulling nails. The ripping hammer has straighter claws designed more for ripping woodwork than for pulling nails. Both types of hammers come in 6 to 28 oz. head weights.
• Carpenter's Hammers (1)	*During the practice periods, supervise the students carefully to see that they are using the correct procedures.*	Parts of the claw hammer head are: face, poll, neck, check, eye, and claw. The head is fitted to the handle. Better hammers have a hickory handle, a forged head, and a slightly belled, or convex, face.
• Machinest's Hammers (1)		The most common type of machinist's hammer is the peen hammer, with the ball peen being the most widely used. The principle parts of a peen hammer are: the peen, the eye in which the handle fits, the post, and the face. Peens come in different shapes such as ball, straight, and, cross. Peen hammer heads range from 2 oz. to 48 oz. with 8 and 16 oz. being the most common.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Machinest's Hammers (1) (cont'd)		Soft hammers are used to strike objects which can be easily marred or damaged. They have striking surfaces of lead, brass, plastic, and rawhide. Some soft hammers have detachable tips which are color coded to identify hardness.
Use (2)		When using hammers, consider the following hints: • Always use a hammer of the appropriate size. • Grasp the hammer handle so that the heel of the hand is nearly flush with the bottom of the handle. • Always strike an object squarely so that the face of the hammer is parallel to the object being struck. This protects both the hammer and the surface struck. • Use wrist motion almost exclusively to strike light blows with a hammer. For heavier blows, use the wrist and forearm. Heavy blows come from the wrist, forearm, and shoulder. • Never use a hammer with a damaged or loose head or handle. • Never strike an object with the side of a hammer.
• Carpenter's Hammers (2)		To start a nail, place the hammer face on the nail and then give the nail a couple of taps before driving the nail into the wood. Bent nails commonly result from using too light a hammer or not striking the nail squarely. Properly driven nails should sink with only a few firm blows. Once the nail has been started, keep the fingers away from it.
• Machinist's Hammers (2)		When using a machinist's hammer consider the following hints: • A hammer face should be at least one-half of an inch larger than the tool it is striking such as a cold chisel or punch. • Wear safety glasses when using a machinist's hammer. • Know which soft hammers are appropriate for what material and use them accordingly.
Care and Maintenance (3)		Because hammer use requires considerable force under some conditions, hammer maintenance is vital to guard against flying heads, chips in eyes and face, and mashed fingers.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Care and Maintenance (3) (cont'd)		Keep hammer handle and head free from grease and dirt. Give the hammer a solvent bath when necessary. Use oil and a soft cloth to clean and polish the hammer head occasionally. If the hammer head becomes loose, resink the old handle wedges and/or drive in new ones.

BORING AND DRILLING TOOLS

PUNCHES

Identifies various types of punches and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various types of punches*

2 *Explain and demonstrate the safe and efficient use of various types of punches*

3 *Explain and demonstrate the correct care and maintenance procedures for various types of punches*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

(B) Whitt, Donald, ed. *Basic automotive tools and how to use them.* Los Angeles, Calif. Petersen Publishing Co., Inc. 1974.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
	This module should be flexible. If other tools would be more appropriate than the ones presented, include them at the proper place in the sequence. Identify them and explain their use, care, and maintenance.	
	Give anecdotes and tips about the various tools to emphasize points relative to their use and maintenance.	
	Have the actual tools being discussed in class available for reference to their specific parts and use.	

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Types (1)	*Develop practical situations that require the use of punches which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs. (Ref. A, p. 113; Ref. B, pp. 160-163)*	
• Taper Punch (1)		Taper punches have very long tapered bits and flat points. They come in a variety of lengths and diameters and are used primarily to align holes in pieces of metal so that bolts and screws can be inserted.
• Drift Punch (1)		A drift or pin punch is used to knock pins from holes in which they have been inserted. Drift punches have straight (not tapered) bits and flat points.
• Center Punch (1)	*During the practice periods, supervise the students carefully to see that they are using the correct procedures.*	A center punch has a tapered bit with a broad sharp point which is ground to an angle of 60°. It is used primarily for making indentations in metal so that drills can be started more easily. More expensive center punches have their own spring loaded striking mechanism and do not require a hammer.
• Prick Punch (1)	*Have students practice making an indentation at the intersection of two lines on a piece of sheet metal until their accuracy meets the minimum standard required for their particular trade.*	The prick or aligning punch has a tapered bit and a point ground to a 30° angle, narrower than the center punch. When struck with a hammer it makes finer marks and is therefore used for precision marking. The bit is also used to lineup holes in pieces of metal, much like a taper punch bit.
Use (2)		When using punches consider the following hints: • Select the punch most suitable for the job. Even though punches are designed to be used with hammers, they are not indestructable. • Be sure the punch is not greasy or slippery. • Always strike a punch squarely with the hammer.
• Center Punch (2)		To indent metal accurately for drilling, locate where the hole should be. Then place the center punch on that spot by tipping the punch slightly so both the hole location and the position of the punch point may be seen. Bring the punch up perpendicular to the metal surface, holding the punch with the thumb and first two fingers and resting the third finger on the metal to steady the punch. Strike the center punch squarely with a hammer. Check to determine that the indentation is in the right location.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Prick Punch (2)		The prick or aligning punch is used in the same manner as a center punch to make indentations in metal. To use the punch to align holes, insert the punch in the holes and gently rock it back and forth to bring the holes into line.
• Pin Punch (2)		Using the proper size pin punch is a must. Too small a punch may bend, or gouge the inside surface of the pin hole. Too large a punch will increase the diameter of the hole.
Care and Maintenance (3)		By now students should be getting some idea of general tool maintenance. Keep punches clean. Wipe them off before returning them to the tool chest for storage. Occasionally punch heads get mushroomed. When this happens, do not use the punch until the head has been ground smooth, because pieces of a mushroomed head may fly off when struck. Wear safety glasses when using the grinding wheel. Remove as little metal from the head as possible. Do not grind it for long periods. Quench it with water frequently.
• Center and Prick Punches (3)		Center and prick punches occasionally become dull and require sharpening. Accurate sharpening takes skill and practice. Follow the usual procedures for grinding and sharpening. Check the point surface frequently with a gauge to insure a 60° or 30° point.

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Electric Drills and Drill Bits

Identifies electric drills and various types of drill bits and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various parts, types, and sizes of electric drills, drill bits, and accessories*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

OBJECTIVES

2 *Explain and demonstrate the safe and efficient use of twist drills with electric motors*

3 *Explain and demonstrate correct care and maintenance procedures for drills and drill motors*

REFERENCES

(B) Whitt, Donald, *ed. Basic automotive tools and how to use them.* Los Angeles, Calif. 1974.

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CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Electric Drills (1)	*Develop practical situations that require the use of electric drills which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs.* (Ref. A, pp. 110-117; Ref. D, pp. 72-86)	Basic features of an electric drill and motor are the following: Top air outlet slot, chuck, motor gears, bottom air outlet slot, fan, motor, trigger switch, automatic trigger release, motor brushes, and air inlet. The chuck, that part of the drill which grips the bit, has three jaws which are opened and closed with a key. Some electric drills come with extra handles which can be detached. Electric drill motors also come with extra handles which can be detached. Electric drill motors are available with different power ratings and can accept different sizes of bits. Generally, the more powerful the drill motor, the larger the bit it will accept.
Twist Drills (1)	*During the practice periods, supervise the students carefully to see that they are using the correct procedures.*	The following are the parts of a twist drill: • Margin — the cutting edge which spirals around the body • Flutes — the grooves which spiral up the body between the margins. • Shank — the smooth portion of the drill which is held by the chuck • Body — that portion of the drill which the margins run along • Axis — the centerline of the drill • Lip or cutting edge — at the tip of the drill • Heel — the outer radius of the tip of the drill • Dead center — the center of the tip • Body clearance — the distance between the adjacent edges of the margin • Web — the width of dead center at the tip of the drill

CON'	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
		The number of flutes and the width of the web generally determine the material for which the drill is suited. Types of specialty drills include multi-groove, oil hole, straight flute, extension, and skin. Center drills and countersinks and counterbore drills are also used in starting and finishing drilled holes. Drills come in different sizes. After use and on very small drills, the size becomes illegible. Drill size gauges are available to determine the size of the drill. Three types of gauges correspond to number, letter, and fractional sizes of drills. Conversion charts exist which tell what letter or number is equivalent to what fractional size.
Use of Electric Drills (2)	Demonstrate how to start a drill in wood and sheet metal. *Provide practice periods and supervise students carefully to see that they are using the correct procedures.*	With an electric drill, as with any power tool, always use the third pin on the plug. This is the ground for the power tool. Failure to ground this tool or other electric tools properly can result in severe injury or even death. Select an appropriate bit of the right size. Place it in the drill chuck so that some of the drill shank is still showing. Tighten the chuck firmly, making sure that the drill is properly centered. Run the drill slowly if possible while checking to see if the bit is straight and properly centered. A rough rule of thumb for the speed of the drill is the smaller the drill, the faster it should turn and the more quickly it should be fed into the work. This is modified by another rule of thumb which indicates the softer the material being drilled, the higher the speed. Any drill which squeeks in a hole may soon overheat and lose its temper. Always make sure that the work being drilled is secure, otherwise it may catch on the drill and start spinning, possibly breaking the drill and hurting somebody.
Care and Maintenance (3)		Never use a drill motor which has a frayed or otherwise defective cord or plug. Do not drop a drill motor or slam it around. It is a relatively complicated piece of machinery and deserves to be treated as such. Wipe off the drill motor housing before returning it to the tool chest.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Drill Motors (3)		Store the drill motor in a clean dry place, preferably in the box it came in or in some other protective covering. It is usually a good idea to keep the chuck key in a readily accessible place or attached to the cord of the drill, as it may have been when it was bought. It is difficult to firmly tighten the chuck without the key. Most new drill motors come with an owner's manual. Read it and follow its directions for care and periodic maintenance. If the drill does not have such a manual, take it to a reputable dealer for periodic service and have him explain how to keep the drill motor in good working order.
• Drills (3)	Demonstrate how to sharpen a drill. Emphasize the safety precautions to follow when sharpening a drill on a grinder. *Provide practice periods and supervise students carefully to see that they are using the correct procedures.*	Drills are cutting tools which lose their effectiveness if their edges are dulled. Keep the edges sharp and the drills in good condition by following the procedures listed below: • Do not store drills loosely in the tool tray or they will become dull. • Store drills in their own case so that they do not come in contact with each other. This way their size may be readily identified and missing drills noted at a glance. • Keep drills lightly coated with oil to prevent rust. Drill sharpening is a real art, requiring knowledge, skill, and special measuring tools. If drills are used a great deal, a drill sharpener is a good investment.

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Braces and Auger Bits

Identifies braces and auger bits and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this part students will be able to:

1 *Identify various parts, types, and sizes of braces and auger bits*

2 *Explain and demonstrate the safe and efficient use of braces and bits*

3 *Explain and demonstrate correct care, maintenance, and storage procedures for braces and auger bits*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Types of Braces (1)	*Develop practical situations that require the use of braces and auger bits which will give students an opportunity to improve their proficiency using these tools in relation to their individual occupational needs.* (Ref. A, pp. 42-51, 95)
Types of Auger Bits (1)	*During the practice periods, supervise the students carefully to see that they are using the correct procedures.*

BACKGROUND INFORMATION

A bit brace is the basic tool for drilling holes in wood. Common types of braces are: the bit brace, the corner brace, and the short brace.

Basic parts of a bit brace, starting at the chuck end are: chuck, ratchet control (which is usually reversible), handle, and head which is the round wooden knob opposite the chuck.

Common auger bits are classified according to the number of twists per inch and the speed with which they cut — fast which has a coarse thread and few twists per inch while medium and slow have fine threads and many twists per inch.

Types of auger bits include: ship auger, double twist, and single twist, solid center.

Other types of bits which do not have the characteristic thread arrangement are: the gimlet bit which is used to bore screw holes, the Foerstner bit which is used for boring holes in end wood or for boring very accurate holes, the bell hanger's drill which is not damaged by metal, and the adjustable expansion bit.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Types of Auger Bits (1) (Cont'd)		Common auger bits are sized by sixteenths of an inch from 1/4" to 1". The parts of the cutting end of an auger bit are: the screw point, the cutting edge of the lip, the spur or nib, and the twist.
Use (2)		When starting a hole make certain that the bit chuck is tight. Mark the center of the hole to be drilled with an awl. Place the point of the screwpoint directly on the center mark and slowly twist the brace. When the spurs of the auger bit touch the surface, check the position of the bit with a try square to make sure it is perpendicular to the wood's surface. Apply the proper amount of pressure and start boring slowly. Boring a hole in wood entirely from one side usually splits the wood on the other side. To prevent this, bore the hole from one side until only the tip of the screw point shows on the other side. Back out the bit and using the screw point hole as the center point of the hole, start boring from the other side. This will produce a clean hole. When using a brace and bit, consider the following hints: • To bore one hole or a series of holes to a certain depth, make a depth gauge out of a wooden block which is cut to the proper length and bored to the proper diameter. • To start a hole at a slight angle, use a line drawn on cardboard or a thin piece of wood as a reference mark. To start a hole at a larger angle, bore a block of wood to the proper size, saw the end to the proper angle, and clamp or nail the block to the boring surface.
Care and Maintenance (3)		
• Braces (3)		Keep the brace clean, especially the chuck and ratchet mechanism. Oil the ratchet mechanism and chuck lightly if necessary. If the wooden handle or head becomes dried out and is about to crack, oil it using an appropriate type of oil. Store the brace in a clean, safe, accessible place.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Bits (3)		Bits are cutting tools. Their edges should be preserved and maintained. Store them separately from other tools, preferably in a rack or case, separated from each other. If no rack is available wrap each bit separately in cloth and store the bits in a box. Lightly oil the bits to prevent rust if they are to be stored for long period of time. Bits used to bore hard wood get dull quickly and must be sharpened periodically. Use a specially designed auger file which is small, double ended, and tapered. Fix the bit firmly in a vise. File the nicks from the *top* side of the cutting edge of the lips to maintain the proper clearance on the under side. Nibs or spurs are filed on the *inside* only to maintain the proper diameter of the bit. Finish the filed edges with a slipstone. As with all filing and sharpening of hand tools, remove as little metal as possible to get a sharp edge.

SOLDERING

Identifies the equipment and materials used in soldering and explains how to use and maintain them in a safe and efficient manner

OBJECTIVES

At the completion of this module students will be able to:

1 *Identify various types of equipment and materials used in soldering*

2 *Explain and demonstrate the sequence of operations used in soldering*

3 *Explain and demonstrate correct care and maintenance procedures for soldering irons*

REFERENCES

(A) Morgan, A.P. *How to use tools.* New York, N.Y. Arco Publishing Co., Inc. 1955.

(B) Stockel, M.W. *Auto service and repair.* South Holland, Ill. Goodheart-Willcox Co., Inc. 1975.

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CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Equipment and Materials (1)	*Develop practical situations that require soldering which will give students an opportunity to improve their proficiency using these processes in relation to their individual occupational needs.* (Ref. A, pp. 122-132; Ref. B)	Solder is a lead and tin alloy used to join two pieces of metal. To do this effectively, it must be heated.
• Solder (1)		Solder comes in bars or ingots, flux core wire, solid wire, and fine grains which are mixed with flux.
• Flux (1)		Soldering flux is used to remove oxide which forms on metal surfaces.
	During the practice periods supervise the students carefully to see that they are using correct procedures.	Acid flux is used in nonelectrical work, because it leaves a conductive residue after it is heated. Because it is also corrosive, it should be cleaned off the joint after it has cooled.
		Rosin or resin flux is used for electrical work. Its flakey residue can be easily removed after the joint has cooled. Many people solder with rosin core solder.
	Have students practice soldering electrical connections and making and soldering electrical wire splices. If equipment is available, check the soldered electrical joints and splices for	Flux is as necessary to soldering as the solder itself. Most jobs cannot be done without it.
• Soldering Irons and Guns (1)		Most soldering irons are heated by electricity. However, some must be placed in a gas flame or furnace.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Soldering Irons and Guns (1) (cont'd)	*electrical resistance. Also, have students practice sweating two pieces of appropriate metal together.*	Soldering guns, unlike irons, heat up very rapidly and are most useful in short operations on electrical wiring.
Sequence of Operations (2)		
• Cleaning (2)		All surfaces to be soldered should be free of any trace of paint, rust, grease, etc. To do this, use a brush, file, emery cloth, grinding wheel, cleaning solvent, etc. If you are soldering a metal joint, smooth the surfaces so they will be well-fitted.
• Tinning an Iron (2)		The copper tip of a soldering iron often becomes pitted and corroded. Solder will not freely flow off such a tip. Before plugging the iron in, use a file to dress the tip surfaces smooth and flat down to the bare copper. Plug the iron in. When the tip changes color to brown and light purple, dip it in a can of rosin paste soldering flux. If no can is available, use rosin core wire solder. If the iron is sufficiently hot, the solder will flow freely around all sides of the tip. If too much solder sticks to the tip, wipe off the excess quickly with a cloth.
• Making a Joint (2)		Hold the iron so that as much of the tip as possible contacts the joint. This speeds up heat transfer and makes a better joint. Apply the solder to the edge of the work adjacent to the iron, not to the top side of the iron tip. Do not move the work until the solder has set. If the joint is disturbed before it has set, fracture lines may occur which will produce a weak joint.
• Sweating (2)		"Sweating" involves tinning the contact surfaces of two pieces of metal to be joined, placing them together, heating them, and, in some cases, maintaining pressure on them until the solder has set.